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Psychosocial Characteristics of Optimum Performance in Isolated and Confined Environments (ICE)

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Objectives

❑The Behavioral Health and Performance (BHP) Element addresses human health risks in the NASA Human Research Program (HRP), including the Risk of Adverse Behavioral Conditions and the Risk of Psychiatric Disorders. BHP supports and conducts research to help characteristics and mitigate the Behavioral Medicine risk for exploration missions, and in some instances, current Flight Medical Operations.

❑The Behavioral Health and Performance (BHP) Element identified research gaps within the Behavioral Medicine Risk, including Gap BMed6: What psychosocial characteristics predict success in an isolated, confined environment (ICE)?

❑To address this gap, we conducted an extensive and exhaustive literature review to identify the following: 1) psychosocial characteristics that predict success in ICE environments; 2) characteristics that are most malleable; and 3) specific countermeasures that could enhance malleable characteristics.

Materials and methods

- ❑ The review of the literature on isolated and confined environments was modeled after the format used by the Cochrane collaborative in preparing systematic reviews of the literature (Higgins & Green, 2006). This format includes details on the search strategy, description of selection criteria for studies to review, and review methods.
- ❑ Searches of published and unpublished studies were then conducted using the following sources of information: electronic data bases, including the National Library of Medicine's PubMed Central, PsycINFO, Social Sciences Citation Index, and Sociological Abstracts; specialist bibliographies such as the Antarctic Bibliography; unpublished technical reports and manuscripts; and library catalogs for books on isolation and confinement in extreme environments. Search terms included isolation, confinement, extreme environments, human behavior, and performance. These materials were then reviewed to identify studies that described specific psychosocial characteristics as being associated with one or more measures of behavior and performance.
- ❑ Studies that included outcome measures of behavior and performance in isolated and confined environments but did not include psychosocial characteristics as potential predictors of these outcomes (e.g., studies that examined whether duration of exposure to isolation and confinement or changes in circadian rhythms were associated with behavior and performance) were excluded from further review. This left us with a sample of 120 studies for analysis.
- ❑ Studies were assigned values based on whether they were anecdotal or reviews (score = 0) or whether they reflected quasi-experimental (cross-sectional or longitudinal observational designs) (score = 1) or experimental (randomization of participants or conditions of isolation and confinement) designs (score = 2).
- ❑ Psychosocial characteristics identified in the studies reviewed included social-demographic characteristics, personality characteristics, clinical evaluations, coping skills, and other characteristics of individuals, as well as characteristics of groups and their leaders.
- ❑ Measures of performance were grouped into five categories, task ability, emotional stability, social compatibility, leadership, and overall performance.
- ❑ When available, data contained in the papers were used to identify correlation coefficients (Pearson's or Spearman's r), odds ratios, and effect sizes (Cohen's d) for all associations reported to be statistically significant.
- ❑ A coding system was developed to prioritize variables based on the fidelity of the study design to long-duration missions in space. A fidelity score was calculated for each study by summing the scores of 4 variables.
  - Similarity to spaceflight
  - Similarity of study participants to long-duration expedition astronauts
  - Similarity with respect to duration of mission
  - Similarity to crew size
- ❑ Finally, psychosocial characteristics identified from studies with quasi-experimental or experimental designs were prioritized based on 3 variables: 1) the number of studies reporting a statistically significant association or associations between a particular characteristic or cluster of characteristics and one or more indicators of performance; 2) the average fidelity score of these studies; and 3) the magnitude of the statistical effect reported for these associations in these studies.
  - No effect reported = 0
  - Small effect = 1
  - Medium effect = 2
  - Large effect = 3
- ❑ Characteristics were then placed into 3 groups for each type of performance predicted: 1) the 3 most important predictors; 2) other important predictors that were based on 3 or more studies reporting statistically significant associations; and 3) less important predictors that were based on 1 or 2 studies reporting statistically significant associations.

Results

Table 1. Quantity, quality and fidelity of studies reporting associations between psychosocial characteristics and performance

Psychosocial Characteristic Category	Performance categories	Statistically significant associations	Mean fidelity score	Small effect X 1	Medium effect X 2	Large effect X 3	Overall effect score
Demographic cluster A (maturity, experience, skills)	5	43	7.53	12	4	0	20
Demographic cluster B (unmarried)	4	6	7.17	0	1	0	2
Demographic cluster C (cultural background)	2	4	8.75	2	1	1	7
Personality cluster A (global traits)	5	44	9.04	13	11	6	53
Personality cluster B (motivation)	5	35	7.83	7	9	7	46
Personality cluster C (mood)	4	10	8.50	2	3	1	11
Personality cluster D (cognition)	5	6	8.17	0	5	1	13
Personality cluster E (self-efficacy)	5	16	8.38	5	4	1	14
Personality cluster F (interpersonal)	5	41	7.56	16	8	4	44
Clinical characteristics	4	11	8.45	1	3	2	13
Coping resources and strategies	3	7	7.14	3	0	1	6
Other characteristics	4	16	8.14	2	3	2	14
Group cluster A (homogeneity/heterogeneity)	3	21	7.10	1	3	5	22
Group cluster B (cohesion)	3	13	7.69	0	0	0	0
Leadership cluster A (style)	4	12	7.00	0	0	7	21
Leadership cluster B (skills)	3	10	7.30	0	0	2	6

Table 2. Prioritization of predictors by performance category

Prioritization Level	Performance Measure				
	Task ability	Emotional stability	Social compatibility	Leadership	Overall
I. Top 3	Global personality traits Crew homogeneity/ heterogeneity Interpersonal needs and skills	Age, maturity, experience and skills Interpersonal needs and skills Global personality traits	Crew homogeneity/ heterogeneity Global personality traits Interpersonal needs and skills	Leadership style Global personality traits High motivation	High motivation Global personality traits Interpersonal needs and skills
II. Other Important	Age, maturity, experience and skills Group cohesion	Civilian status Clinical characteristics Mood High motivation Group cohesion High self efficacy Cultural background	Age, maturity, experience and skills Group cohesion High motivation Cultural background	Leadership skills Interpersonal needs and skills High self-efficacy Age, maturity, experience and skills	Age, maturity, experience and skills High self-efficacy Clinical characteristics Mood Leadership skills Coping characteristics
III. Less Important	High self efficacy High motivation High alertness Low hostility against the self Large groups High positive affectivity Number of previous expeditions High religiosity Unmarried Male gender Military/civilian status Urban residence.	Crew homogeneity/ heterogeneity Male gender Military service Urban residence High alertness High need for orderliness High conscientiousness High satisfaction with social support Low use of acceptance as a coping strategy Number of previous expeditions Enjoyment and sense of awe of the environment High/low interest in hobbies and leisure activities Low religiosity Large/small crew sizes Participative/supportive leadership style	Clinical characteristics Coping characteristics Enjoyment and awe of the environment Low interest in hobbies and leisure activities High religiosity Low work-related stress Low hostility against the self High alertness Large crews High positive affectivity Rural residence Military service Male gender Unmarried Participative/supportive leadership style Leader's ability to adapt style to context	High alertness High expressed control Married.	Cognition High/low interest in hobbies and leisure activities Military/civilian status Female gender Low family socioeconomic status Married/ unmarried Rural residence High openness to experience High religiosity Leaders' use of recognition and reward

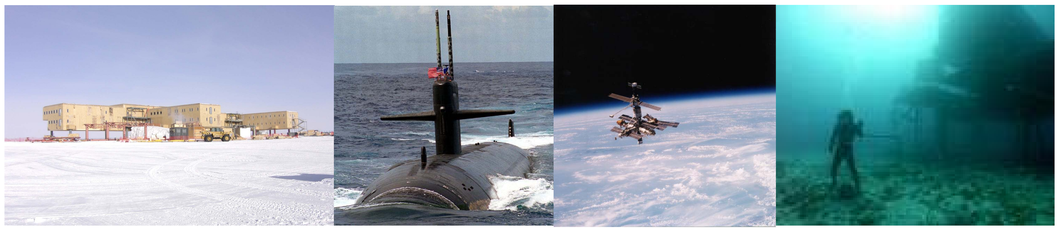

Table 3. Countermeasures for Performance Enhancement

Screening	Selection	Training
▪ Global personality traits ▪ Mood ▪ Interpersonal needs and skills ▪ Self-efficacy ▪ Leadership style and skills ▪ Coping skills and strategies	▪ Demographic characteristics reflecting age, maturity, experience and skills o Older age o Occupation o Years of work experience ▪ Personality characteristics o Global personality traits o Motivation o Mood o Interpersonal needs and skills o Self-efficacy ▪ Group characteristics o Homogeneity of demographic and personality characteristics o Heterogeneity of selected personality characteristics o Group cohesion ▪ Clinical characteristics o Predeployment clinical evaluations o High positive affectivity ▪ Leadership style and skills ▪ Coping skills and strategies ▪ Number of previous missions/expeditions	<u>Social Skills Training</u> ▪ Interpersonal needs and skills ▪ Cultural background ▪ Crew homogeneity related to demographic characteristics, culture and personality ▪ Group cohesion ▪ Coping resources and strategies o Social support use and satisfaction ▪ Leadership style and skills ▪ Participative/supportive style ▪ Ability to maintain group harmony and resolve conflicts ▪ Global personality traits o Extraversion <u>Psychotherapeutic Interventions</u> ▪ Motivation ▪ Mood ▪ Global personality traits ▪ Interpersonal needs and skills ▪ Group cohesion ▪ Coping resources and strategies <u>Leadership Training</u> ▪ Leadership styles and skills ▪ Group cohesion ▪ Crew homogeneity related to demographic characteristics, culture and personality <u>Cross Cultural Training</u> ▪ Cross cultural differences in emotional stability and social compatibility ▪ Crew homogeneity related to culture

Conclusions

- ❑ Despite the wealth of research on psychosocial characteristics in isolated and confined extreme environments, the evidence supporting any one particular characteristic as a predictor of performance is quite limited.
  - Of the 120 studies examined, slightly more than one-third possessed data that could be used to identify a statistical effect.
  - The number of associations supported by more than two studies was 15 (4.5% of all associations).
- ❑ The most robust associations, based solely on statistical effects and/or fidelity scores, were between emotional stability and age, education/socioeconomic and civilian status, being unmarried, and compatibility of social dyads; between social compatibility and age, enjoyment and awe of the environment, and crew homogeneity related to demographic characteristics, culture and personality, and between overall performance and education/socioeconomic status, an introverted personality, and high need for achievement and high motivation.
- ❑ Malleable state characteristics such as depressive symptoms and certain traits such as susceptibility to anxiety and perhaps even introverted personalities may be addressed through cognitive behavioral therapy, interpersonal therapy, and other techniques that are evidence-based. Fixed traits such as age, education/socioeconomic status and marital status are potentially enhanced in crews through programs of screening and selection.

Literature cited

Higgins J, Green S (eds.) (2009). Cochrane handbook for systematic review of interventions 4.2.6 (The Cochrane Library, Issue 4). Retrieved October 6, 2009, from http://www.cochrane.org/Resources/handbook/Handbook.pdq.

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